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ABSTRACT

The extent to which computers are presently used for instructional purposes is surveyed. The evaluation of computers and the more recent development of computers for education are traced. The growth of computer-assisted instruction centers and instructional computer languages is described. Computers, terminals, telecommunications, computer languages, and course programs are reviewed with respect to the equipment presently available in Canada, the United States, and France. Examples are given of the many types of computer terminals in use. Next, the classifications of computer use are illustrated by current examples. Each of the major areas of use--laboratory tool, instructional management tool, and teaching instrument--is treated separately. Finally, organizations and associations involved in the instructional use of computers are listed and described. (WH)

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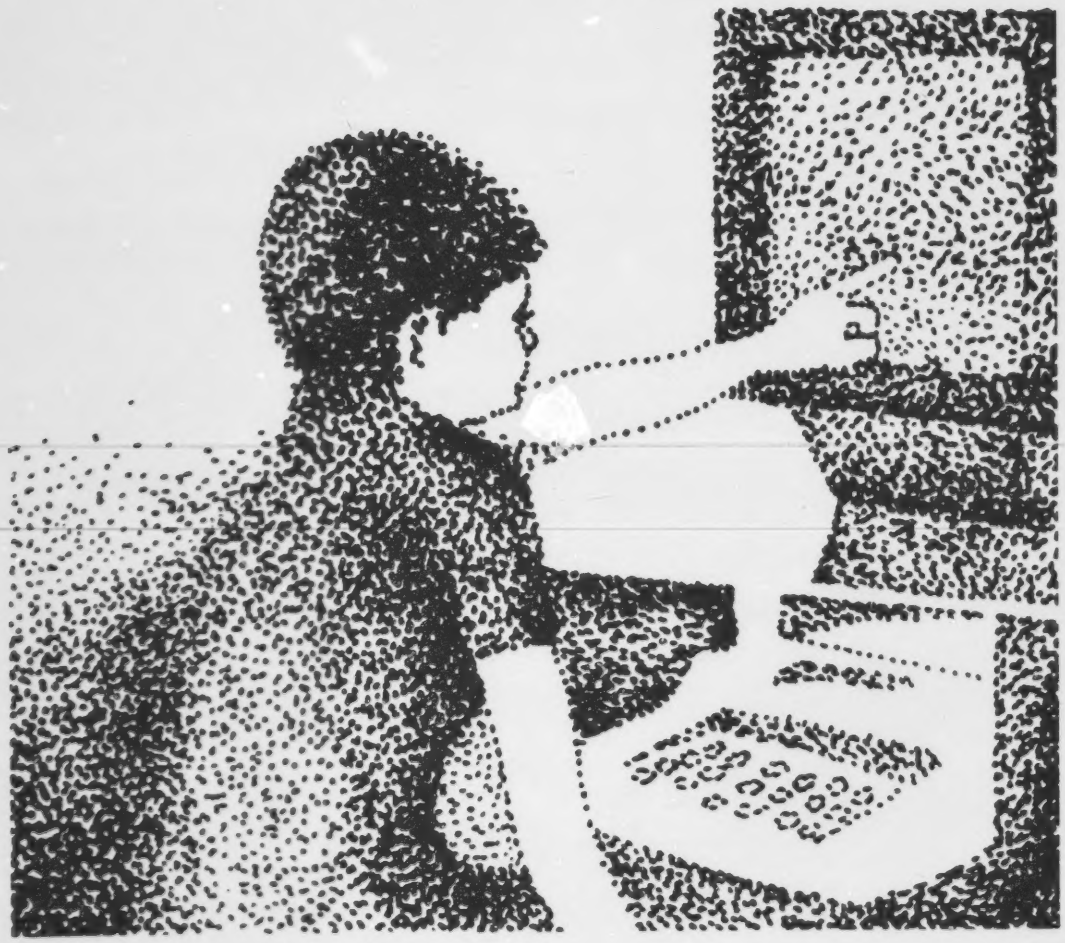
Report on The Instructional Use of the Computer

Volume III
Scope



Service de l'Informatique
Ministère de l'Education
Province de Québec
Canada

IR 000 946

ED 092088

Report on

THE INSTRUCTIONAL USE OF THE COMPUTER

Volume III

SCOPE

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Service de l'Informatique
Ministère de l'Éducation du Québec
March 1973

The instructional use of the computer

Volume III

SCOPE

The three volumes* of the document "The Instructional Use of the Computer" are the result of a report submitted to the Department of Education in March 1973 by the Laboratoire de Pédagogie Informatique. This study, directed by Mr. William Lee, continues the work done by the Laboratory set up in 1968 within the Department of Education's Data Processing Service.

In the first volume the classification and description of the types of instructional uses to which the computer may be put are the work of Guy Chevalier and the experiment reports, the work of Bernard Gateau.

The second volume on the costs of the various computer uses was written by François Labrousse.

The third volume which describes the scope of computer use in education is the work of Lucien Dubé.

The final copy was put together and given its finishing touches with the assistance of Miss Diane Laflamme and Mrs. Céline Brochu.

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*Volume 1: "Types of uses"
Volume 2: "Costs"
Volume 3: "Scope"

CLASSIFICATION OF THE INSTRUCTIONAL USES OF THE COMPUTER *

AS A LABORATORY TOOL

- ELECTRONIC EQUIPMENT
- CALCULATOR
- AUTOMATON
- SIMULATOR
- RESEARCH AND DEVELOPMENT TOOL

AS AN INSTRUCTIONAL MANAGEMENT TOOL

- INFORMATION BANK
- TESTING AID
  - ANSWER PROCESSING
  - TEST GENERATION
  - INDIVIDUALIZED TESTING
- COMPUTER MANAGED INSTRUCTION

AS A TEACHING INSTRUMENT

- DRILL AND PRACTICE
- TUTORIAL
- DIALOGUE

*Cf Volume 1 of this report: "Types of Uses"

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CHAPTER I

LINES OF DEVELOPMENT

Development in the data-processing industry took its first leap forward in the early 50's, but only in the early 60's were computers first used for educational purposes. (This does not refer to administrative uses of computers in education or to the teaching of data-processing).

In fact, at the very beginning of the last decade, IBM (in 1960), Bolt, Beranek and Newman (in 1960), the University of Illinois (in 1961) and Stanford University (in 1963) began research on the instructional uses of the computer.

Figures 1 and 2 on pages 5 and 6 give an idea of the increase in the number of large centers since the sixties. In 1966-67 (23), development began in schools. Whitney and White (42) note that in 1968, over fifty organizations were operating a conversational system or leasing the services of their systems. At the time, there were 2000 terminals in use.

In 1969, the University of Wisconsin's index of programs listed 51 centers as sources of computer-assisted instruction programs; in 1970 this figure increased to 86 and in 1972 to 176 (most of these centers are in the United States) (24, 25, 26). This does not include centers or schools which use existing programs without developing their own.

At present, there are some dozen centers doing research in this field in Canada. Research in Québec began in 1968 when the Laboratoire de Pédagogie Informatique was set up within the Department of Education. Several other bodies (30) including some universities followed close behind. In 1972, about 10 colleges were experimenting with computers as instructional tools. An experiment is also being carried out in eight secondary schools within the Montreal Catholic School Commission.

The number of programming languages suitable for instructional purposes increased very rapidly. Within the *laboratory tool* application alone, there are at the moment at least 18 different interactive languages (43). The first was created in the United States by the Rand Corporation which made it available to a privileged group of its researchers in 1964.

Between 1966 and 1969, twelve new languages made their appearance (43). In Canada itself, the National Research Council is interested in the matter. Consequently, a subcommittee of experts from the various parts of the country is working on a Canadian language. This extremely rapid increase in computer languages for instructional purposes is a matter of concern to those who would like to exchange the best programs made. Several researchers and research centers are now studying the problem of incompatible or non-transferable programs.

The previously mentioned growth in the number of centers using computers for instructional purposes (cf figures 1 and 2) was also felt in the development of instructional computer programs. Several program sources may serve to illustrate this development. The ENTELEK guide for instance described 19 programs in 1966, 147 in 1969 and 386 in 1971. The University of Wisconsin index (24, 25, 26) describes a greater number of programs; 456 in 1969, 910 in 1970, 1264 in 1971 and 1766* in 1972. These figures are reproduced in the histogram in figure 3.

This development would have been impossible without public investment. Figure 4, taken from an article by J. Donio published in 1971-72 (19) compares investments in education and in computers used in education in the United States. The author actually points out the exponential character of this development since 1969/70.

This considerable increase in the instructional use of the computer is in part the result of the improvement in computer technology. Two lines of development became evident during the sixties.

---

* This last figure was obtained over the telephone from the person in charge of the fourth edition of the University of Wisconsin index.

The first is a trend towards large *time-sharing* systems. Two factors favor this tendency: the improvement and multiplication of means of communication on the one hand and on the other hand, the development of ever-more powerful computers. One of the best examples of this trend is easily the University of Illinois' PLATO project. Dr. Bitzer's PLATO IV, for instance, is expected to serve 4000 subscribers with only one computer by about 1973/74 (5, 6).

The second line of development might be described as that of the small computer. It originated in the improvement in hardware technology, and particularly in microprogramming and the ever greater miniaturization of circuits. Although at first intended for specialized work, small computers are taking over more and more of the large computers' territory as their processing and calculation capacities develop. Centralized and decentralized systems have become rivals.

Finally, it should be pointed out that in 1968, an American study of the computer market predicted that the number of computers in the United States would reach 75,000 in 1972. This estimate has in fact been doubled. According to the *Computer Yearbook* 72 (14), there were 150,000 computers in 1972.

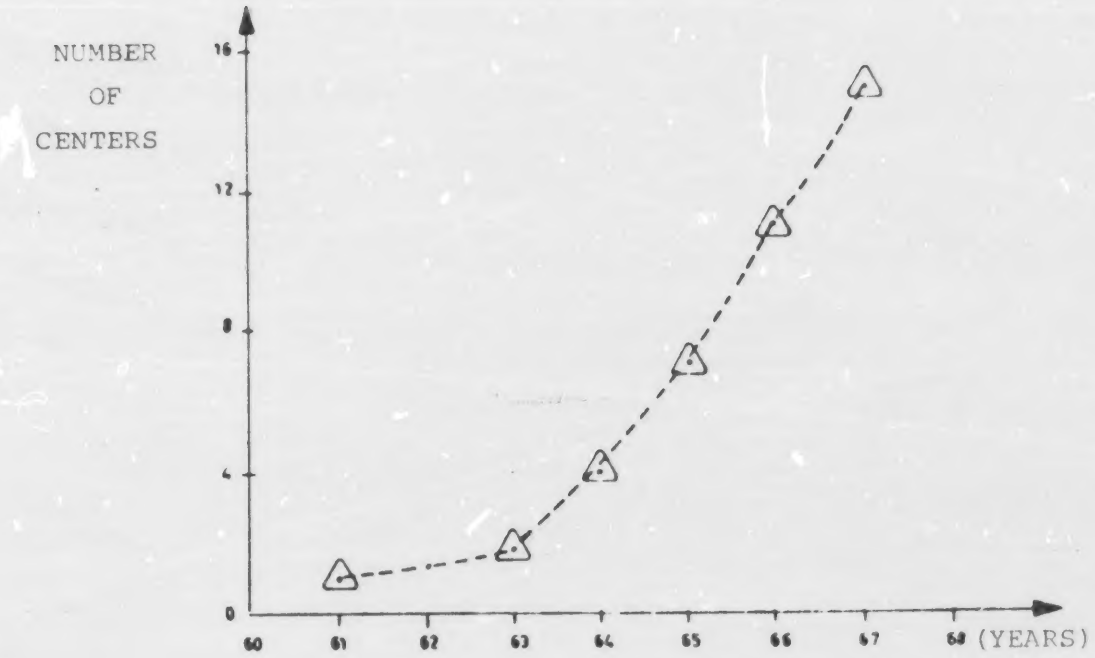

Fig. 1 - *Number of large research centers by year (based on the 1968 ENTELEK guide)*

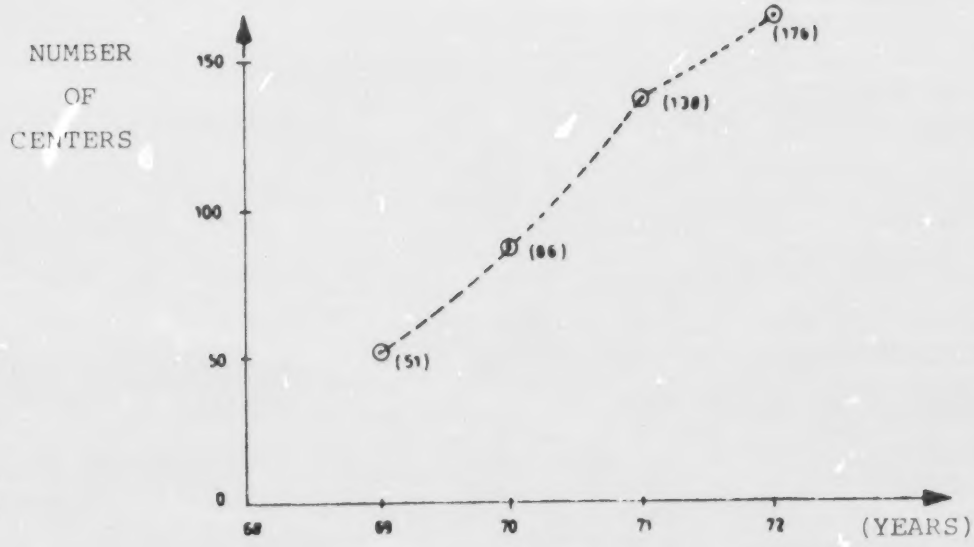

Fig. 2 - *Number of CAI centers by year (based on the University of Wisconsin program* ***index*****).**

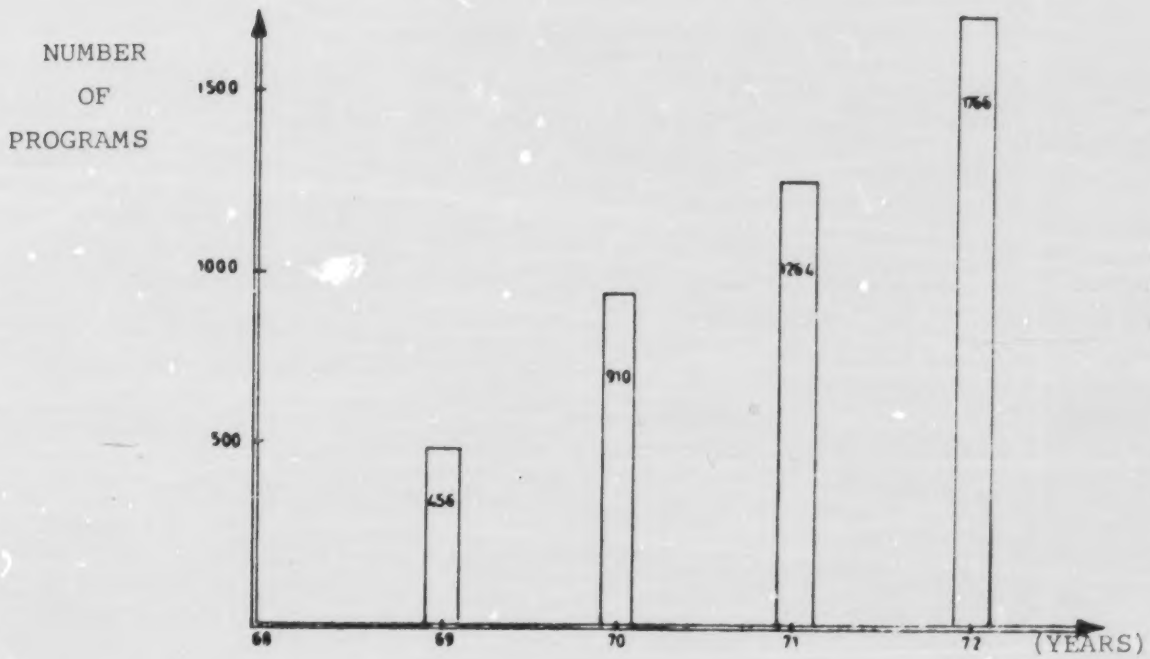

Fig. 3 - *Histogram by year of the number of CAI programs described in the University of Wisconsin index.*

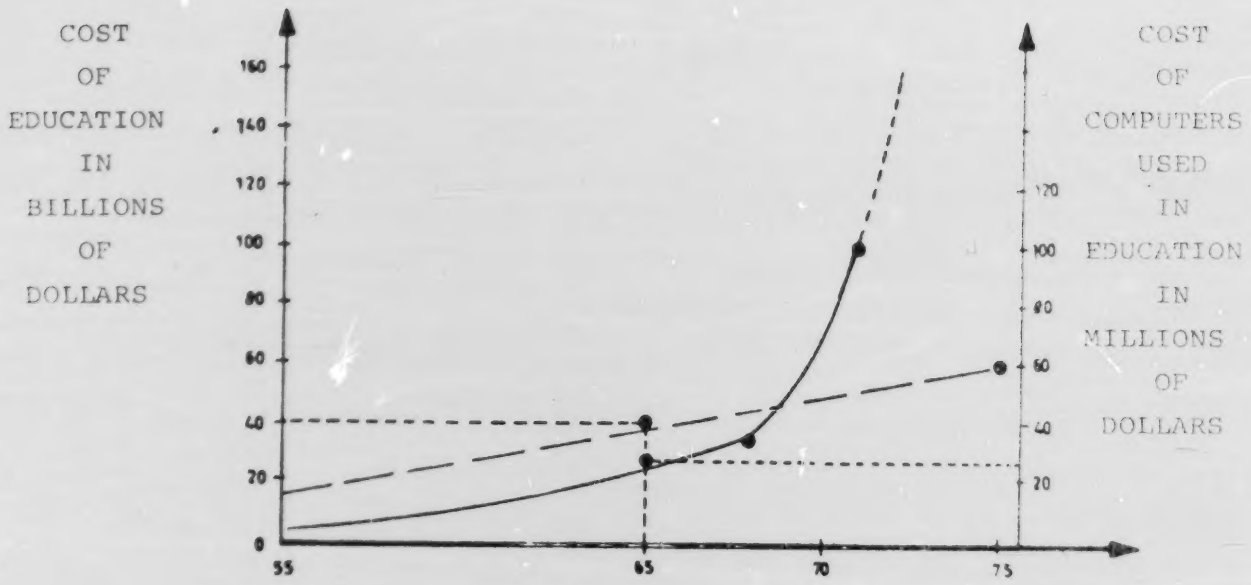

Fig. 4 - *Trend of investments in education and in computers for educational purposes in the United States.*

CHAPTER 2

THE PRESENT SITUATION

2.1 Equipment available

The development of the instructional uses of the computer was itself conditioned by the considerable progress of the data-processing industry over the past 25 years. Three generations of computers have been born in this short period and applications have multiplied with the advance in technology.

Consequently, there are a great number of hardware and software products today. Computers, terminals, telecommunications, languages and programs will be discussed in this chapter.

2.1.1. Computers

Very few complete systems have been made especially for instructional purposes*. The Laboratoire de Pédagogie Informatique has experimented with one, namely IBM's 1500 system. The instructional aspects of this system are found in its software, and its specialized terminals. The computer itself is the 1130 model used in some CEGEP of the Province of Québec.

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* Most computer manufacturers are interested, however, in the instructional uses of the computer. Some work mainly in this field -- Hewlett-Packard's systems are intended principally for educational use.

Most computers can, in fact, carry out the functions required for their use in education. Basically, these functions are:

- data processing: executing programs
- storage: storing programs and data files
- communication: local or remote dialogue with students and teachers.

A system is defined both by the absolute importance given to each of these functions and by the importance of each of these functions in relation to the others.

(a) Large systems

A large system is based on a powerful computer. Using the available programs (26), it is possible to make a list of the principal central computers used for instructional purposes:

CDC 6400 and 6600
IBM* 360/40-50-67
UNIVAC 1108
GENERAL ELECTRIC 635-645
RCA SPECTRA 70

---

* The IBM 370 series computers should also be mentioned. The Department of Education is at present using the 165 model.

The central computer of a large system can manage a sizeable memory and a large number of local or remote terminals at the same time. At first, only a very limited number of interactive terminals were linked together but technological development is expected to make the operation of thousands of terminals possible with one computer. Project PLATO for example, first used an Illiac I operating only one display terminal whereas now, with a CDC 6400, it is expected to handle 4096 terminals. (5, 6)

The advantages of a large system consist in the access to:

- very great computing and processing power
- numerous application programs
- more numerous basic software products (compilers, service routines and so forth)

(b) Small systems

New possibilities were born with advancing technology and the appearance on the market of small and minicomputers. In fact, it has become apparent that a great amount of the work done by large computers could be given to small and even minicomputers. These are generally inexpensive and often eliminate telecommunication costs.

A minicomputer is a unit whose structure makes the solution of specific problems of limited complexity possible at a reasonable price. Most minicomputers are of very flexible construction:

microprogramming, direct access memory channels and so forth. The modular nature of these systems often enables the user to adapt them to his own needs.

There are some thirty minicomputer companies offering about fifty different models (14). Using the program index of the University of Wisconsin, the following list of the small computers most often used in teaching can be drawn up:

General Electric	255-235
IBM	1130 and 1500
Digital Equipment Corporation PDP 8	

The Hewlett-Packard company has marketed its small computer 2000 series. Two french companies are developing small systems. Télémécanique offers two models (T1600 and T2000) and the Cii (Compagnie internationale pour l'informatique) offers Mitra 15. Each of these machines has specialized software for teaching purposes.

Advantages of small systems:

- lower cost for many applications
- decentralization
- adaptability to particular needs.

2.1.2 Terminals

The previously noted development in software permitting direct interaction between the computer and the user (time-sharing) and advances in computer communications brought about a wide demand for terminals to serve in interactive applications. This market thus became one of the most important in the data processing industry*. There are some 306 computer communications equipment companies. In this study attention is given mainly to interactive terminals; typewriter-like terminals, display terminals and certain special terminals.

(a) *Typewriter-like* terminals

These terminals are electromechanical and consequently generally slow. Their printing speed varies from 10 to 30 characters per second. They are robust and reasonably priced. *Teletype* terminals can be used for sending messages between network users as well as for interaction with the computer.

These terminals are very popular at present and serve for most remote applications. Companies now manufacture portable models of such terminals. Besides low cost one of the main advantages of page printers is the record left for the user. Some of them, however, are extremely noisy. New printing methods now make relatively quiet terminals possible.

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* The terminal market in 1972 accounted for half the data processing market. (14)

(b) *Display* terminals

With advances in technology (14) and lower hardware costs it has been possible to commercialize a new quieter type of terminal, the cathode ray tube. For two years, display screens have been developing very rapidly. Every day, new manufacturers are putting better designed, less expensive terminals of this type on the market. The basic element, however, is always the cathode screen, a simple television tube with more or less elaborate circuits with which it can better solve a particular problem: management, education, message posting and so on.

Several companies offer a terminal with an ordinary television screen which can be used as such when not needed as a computer terminal. An American company recently perfected a keyboard with a "dataphone"* incorporated such that any television set can be used as a computer terminal as long as there is a telephone in the same location.

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* The "dataphone" which is also called a "modem" is an instrument used to convert computer binary signals into analog signals which can be transmitted over telephone lines.

There is now a rather large number of display terminal manufacturers: about 100 for alphanumerical terminals and 20 for terminals which also have a variety of graphic possibilities. These latter are not limited to depicting characters on the screen but can trace curves as well, for example. This might double or triple the price. Most of these terminals can be used for instructional purposes if a software system is designed to exploit their potential. The Canadian terminal Lektromedia, for example, was commercialized on the basis of a study done by the National Research Council.

There is a more and more marked tendency in present development to use the cathode ray tube as a computer terminal. One of its advantages is the large number of characters it can display per second. Another is the large quantity of information it can present at once and the capacity to change one piece of information without rewriting the whole. This is a definite advantage for teaching purposes. The lack of a written copy of the information given on the terminal is a great disadvantage in the eyes of some people. To counter this difficulty, several companies offer miniprinters capable of rapidly reproducing the information on the screen. Others achieve the same result with photographic methods.

From an economic point of view, the ability to use an ordinary television set as a computer terminal could prove to be a rather important advantage.

A new display terminal has now appeared on the market. The new principle involved (non-cathode screen) and the hopes it raises have led us to give it special attention. The terminal in question is the plasma display panel developed by project PLATO at the University of Illinois. It offers all the advantages of the alphanumerical and graphic terminals at a much lower cost. Moreover, a built-in device makes it possible to project on the screen any of 256 photographs stored on microfiches and the access time for each photograph is very short. This terminal even allows overprinting of a photograph and a text (6).

(c) Special terminals

These terminals are intended either to do important audio-visual work in education or to serve in a particular type of instructional application.

First of all, there are terminals which are simply previously known instruments controlled by a computer.

2.1.2 ...

(i) Tape recorders

These are ordinary tape recorders to which circuits are added so that a computer can control them and find a pre-recorded message using either the message's address on the tape or the address of the tape itself. In the latter case, the computer controls a bank of tapes and a bank of tape recorders.

Several American schools have this type of installation enabling students to dial a course number on telephones in various places in the school and receive the required course immediatly over special earphones.(2) There is no interaction, however, between the computer and the student.

When these terminals are used in the conversational mode (when different messages on one tape must be referred to frequently) the system's response time can limit the applications. Despite this disadvantage, several applications nevertheless remain possible, particularly at the primary school level. In fact, a terminal with a tape recorder is advantageous when the pupil's reading skills are only barely developed, if at all.

It should be noted that, in all these cases, the computer does not itself compose the message it delivers; it only locates the message on the appropriate recording and

2.1.2 ...

controls the reproduction device. Some of these terminals also make it possible to record the student's voice. Here again, the computer does not analyze the voice. Voice recognition and the composition of oral messages are fields which are being intensively researched (1).

(ii) Video tape recorders

Video tape recorders can also be controlled by computer. As in the above case, the computer can control a bank of video tapes and video tape recorders. Video-taped courses, however, cannot be given on demand as easily as taped courses can. In fact, the video image must be transmitted over a special cable.

When the video tape recorder is used in the conversational mode, applications must allow for the system's response time (time to locate the desired message).

(iii) Slide and filmstrip projection

These terminals are generally ordinary instruments into which circuits are incorporated in order that they may be controlled by computer and the address of a particular image rapidly located.

2.1.2 ...

Here again, response time could limit applications, especially when there is a very large number of images.

We have already seen that project PLATO's plasma terminal dispenses with this difficulty incorporating a device which projects images from micro fiches.

Still among the special terminals are those used for particular applications: sensitive screens, plotting tables and batch terminals.

(i) Sensitive screens

Several terminals enable the user to indicate a particular field on the screen and then see his signal recognized by the computer. The National Research Council of Canada team, for example, has developed a tablet which is sensitive to the touch of a finger. Several cathode screens lend themselves to the use of a light pen. Project PLATO's plasma screen mentioned earlier is itself sensitive to the touch of a finger. This could prove particularly useful at the elementary school level.

(ii) Plotting tables

As indicated by their name, these computer-controlled tables make it possible to plot curves or graphs.

2.1.2 ...

(iii) Batch terminals

All the terminals described above may be used in the conversational mode, that is, for a constant and sustained interaction between the student and the machine. The conventional terminals used for batch processing, however - punched card readers and printers - serve for several instructional uses of the computer.

Visual scanners are being developed which to a certain extent replace card readers in this type of terminal. This development has been particularly marked since 1969-70. The *Computer Yearbook* (14) predicts that in a few years the optical medium will be the main medium for the massive input of computer data. This could lead to a quantity of applications in education since teachers and students could prepare their material for the computer right in the classroom. The first applications will probably concern evaluation but that will not be the end.

(d) Terminal compatibility

The variety of terminals then is considerable, and this creates problems in program exchanges between centers using different terminals. For instance, the number of printing lines, the number of columns and the local functions of the terminal can vary between one brand of display screen and another. The difficulty increases when a program meant for a visual terminal is to be used on a page printer. In fact, the speed at which information appears on a display

2.1.2 ...

screen is limited only by the capacity of the transmission channel and the system to which it is connected. The speed of mechanical terminals, however, is limited by the actual printing process (10 to 30 characters a second).

In conversational applications, the software is usually adapted to the lowest printing speed. This limits the interesting applications of the display screen and any uses in which the information must be printed, as when the computer is used in the conversational mode for *simulation, dialogue, drill and practice* and so forth. There is a trend at present to replace the slower terminals with display screens; this should permit the gradual elimination of terminal incompatibility.

2.1.3 Telecommunications

The first experiments with computer data transmission took place in 1957-58 (14). Developments in computer communications rapidly assumed proportions comparable to development in time-sharing. These two related techniques now make it possible to provide computer services within vast networks.

2.1.3 ...

According to Computer Yearbook 72, the creation of networks will be the major tendency of the next few years. The following figures support this belief: in the United States the major communications company, AT & T, received 1.5 percent of its revenues from data communications in 1958 and less than 10 percent in 1968; by 1980 this could reach 50 percent if competitors do not increase their share of the market (14).

(a) A few technical points

Computer communications make dialogue possible between a computer on one hand and a more or less remote user on the other. A telephone network* generally provides the communication medium. If dialogue is to be possible, however, special equipment must be adapted to the regular network. Traditional channels are in fact designed for analog transmission (voice transmission) and a special unit must be attached to each end of the transmission channel to convert the information into digital (binary) signals. The unit is a modem (modulator-demodulator).

Figure 5 - Diagram of a long-distance communication between a user and a computer.

* Other communication channels will be mentioned further on.

2.1.3 ...

(b) Modem

Some twenty companies manufacture modems - a total of almost 80 different models (14). Characterisitics vary from one model to another. Speed, for example, may reach 100 or 230,000 bauds*. Some can only perform one function, transmission or reception. Others can transmit in both directions, a few simultaneously. Prices vary with these characteristics: a transmission speed of 2,400 bauds costs about three times as much as a transmission speed of 100 bauds. With some modems acoustic coupling is possible permitting data transmission over any telephone. More and more companies offer modems incorporated into the terminal to increase portability.

The competition in this field will certainly lead to reduction in prices. Competition began in 1968 when a law was passed in the United States allowing a user to attach to his communication line devices not furnished by the communication carriers. (14) Several manufacturers took advantage of this law to enter the market.

The next stage will probably be terminals working on a principle similar to that of the push-button telephone and generating audio tones instead of a binary pattern for each character. This would eliminate the modem at the transmitting

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* 1 baud = 1 bit/second. 110 baud is approximately 10 characters/sec.

2.1.3 ...

end (although one would still be required at the computer end). American law does not as yet permit such a development.

(c) Concentrators, multiplexers

Concentrators are used more and more to increase a transmission channel's efficiency. An ordinary telephone line, for example, has a transmission capacity of 2,400 bauds (200-250 characters/second); transmission between the user and the computer is often at a rate of 10,20 or 30 characters per second. It is at this point that concentrators become useful for grouping messages in the same communication channel. For instance, the Department of Education's Data Processing Service transmits at the rate of 10 characters/second between the user and the computer using its ITF system. With a concentrator at each end, the same Montréal-Québec line could serve, about thirty* Montréal users. Figure 6 illustrates the required installations. It should be noted that usually the concentrators are minicomputers.

---

* According to the study Robert S. Mclean of the Ontario Institute for studies in Education presented at the Canadian Conference on educational technology (16, pages 97-105) under the title "A Model of a Centralized CAI System", 32 users could be served in a maximum of 2 seconds with a 1200-baud line, each user having a 300-baud modem.

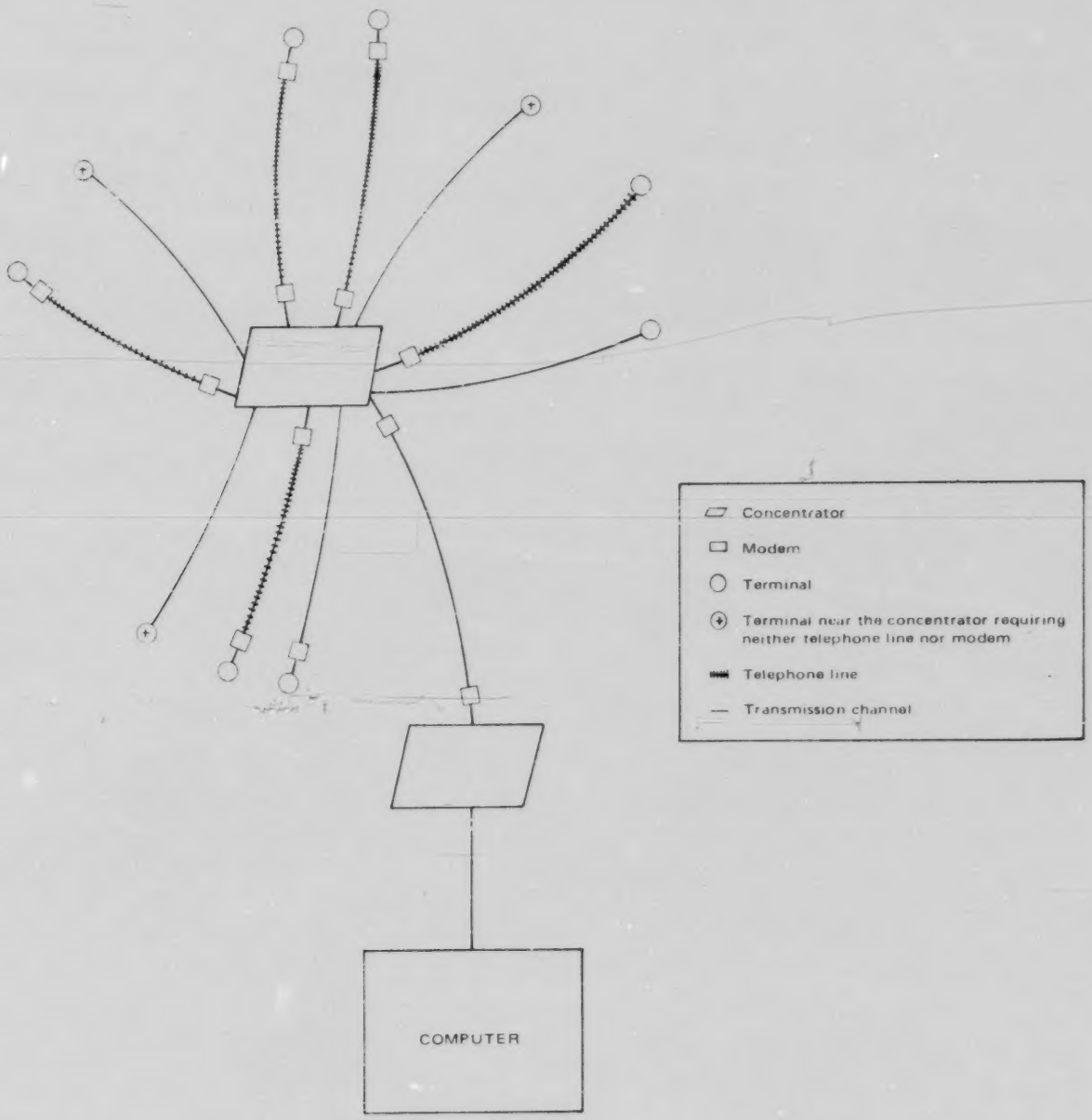


FIG. 6 *Diagram of a system linking several remote users to a computer through a concentrator*

2.1.3 ...

(d) Transmission channels

Other channels can also be used for teletransmission. A television channel with a multiplexer, for instance, could serve 1,000 users simultaneously. PLATO IV uses such a system for data transmission (6). Microwave communications networks are in operation*, satellite communication is already being explored. Comsat (The Communications Satellite Corporation) expects a system of 50 communications satellites to provide 100 million channels for voice transmission before the end of the 70's.

(e) Computer networks

This section will deal with computer inter-connections or service exchanges between data processing centers.

There are several types of information networks. In one, a central computer serves a more or less large number of remote terminals and users. Most of these networks now offer a conversational system as well as the conventional batch processing, as does the network belonging to the Department of Education's Data Processing Service.

---

* In 1970, the American Federal Communications Commission (FCC) adopted a policy which creates and encourages competition in microwave communicationsand other specialized media (14). This opens the way to interesting developments.

2.1.3 ...

The network concept is still evolving, however, which explains the birth during the 70's of networks for the exchange of application software between data processing centers. This phenomenon is particularly evident in university circles.

This does not necessarily imply direct communication between computers but it is nevertheless a first step in that direction. In the United States for example, seventy data processing centers belong to EIN (Educational Information Network), a network set up by EDUCOM, which itself groups 100 universities and colleges, (3). In 1970, 1971 and 1972, the magazine *Automated Education Letter* reported the creation of at least fifteen networks of this type.

Participants in these organizations for exchange generally have as their long or short-term objective direct connections between computers. Most countries are doing research on such computer networks. Specialized networks such as those used for message switching already exist. At present, however, the emphasis is on general networks for exchanging data, programs and resources between participants.

In Canada a university network is being developed (Project CANUNET) (13). There is already a project for exchanging data processing services between the Québec universities and the Department of Education. The American network ARPA is well known. France is working on its Cyclades network (27)

2.1.3 ...

a schema of which is given in figure 7. It will be noted that in this project large and average-sized computers are interconnected.

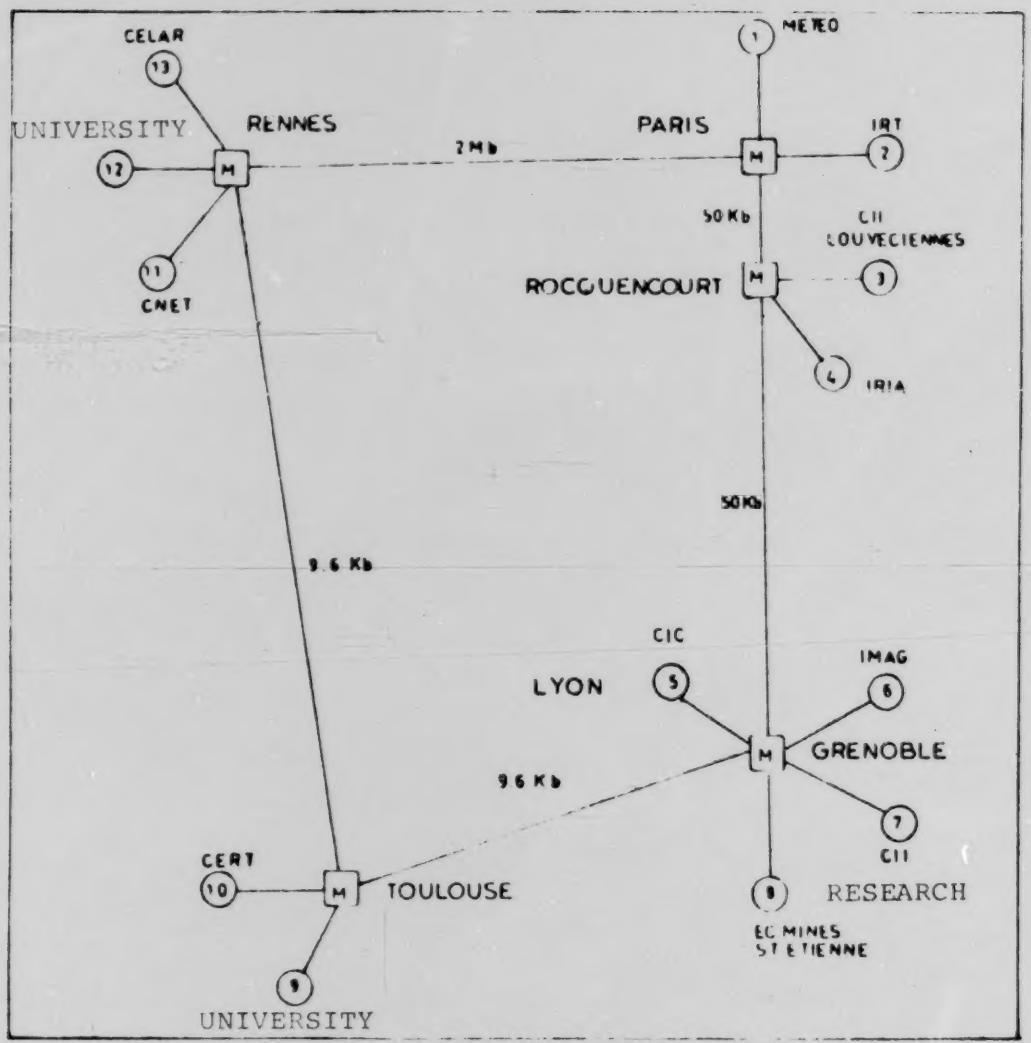
Small computers could also be used in such networks for instructional purposes. In addition to the exchanges normally obtained within such networks, small computers could also request services they are themselves unable to offer their clientele.

The possibility of communication between computer networks is already under consideration. Cyclades and ARPA, for instance, are planning to exchange services in the near future.

(f) Government communications network

To conclude this section on telecommunications, a few characteristics of the government telecommunications network should be pointed out.

The Government of Québec rents a certain number of lines from the telephone companies in order that it may contact various Québec cities at a reasonable cost. Between Montréal and its surroundings, for instance, (Hull, St. Jérôme Joliette and so forth) 85 lines were made available in April, 1972; between Montréal and Québec, 151 lines and between Québec City and its surroundings, 100 lines were made available. These lines are used mainly during the daytime. They could be



LEGEND

1-CDC	6400	8-PHILIPS	P1100
2-CII	10070	9-CII	10 070
3-CII	10070-IRIS 80	10-CII	10 070
4-CII	10070-IRIS 50	11-CII	10 070-IRIS 80
5-CII	IRIS-50	12-CII	10 070
6-IBM	360/67	13-CII	10 070
7-CII	10070		

M MITRA-15

Fig. 7 The Cyclades network (27).

2.1.3 ...

used free of charge evenings, nights and weekends for communicating with the computer.

This means that in April 1972, at least 12,000 students could have worked simultaneously with one or several government computers without it costing them one penny for telecommunications. This figure is based on the supposition that about thirty people could use the same line with concentrators (20 characters per second per user).

This communications network will definitely play a part in the development of the instructional applications of the computer. If we also consider the fact that there is less demand for government computer time on evenings and weekends, it becomes encouraging to make instructional products available to Québec's student body at a reasonable cost. Adult students would thus profit from such a development.

2.1.4 Languages: software

(a) Definition

A data processing language is the medium of communication between man and computer. It is a set of rules and

2.1.4 ...

conventions enabling the machine to understand instructions and answer requests.

Part, though not all, of the software consists of the data processing languages, which are often classified by application. Those in the general category called "languages used for instructional purposes", either facilitate learning or have obvious instructional relevance.

(b) Classification of languages used for instructional purposes

There are now about sixty different languages used in teaching.* Several authors have devoted themselves to classifying them, as, for example Hickey (23) and Frye & Charles (22), whose classifications are based on the data processing characteristics of the various languages.

Of all the classifications of languages used for instructional purposes, we prefer Karl Zinn's (43,44,45,46) which groups the languages according to the instructional possibilities they offer.

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* At one time it was fashionable to create new languages. This profusion led to system incompatibility which constitutes a major problem for centers and researchers interested in language transferability.

2.1.4 ...

The following is his classification:

- description of successive frames or items,
- provision for conversation within a limited context,
- description of a standard procedure by which material is presented,
- specification of an environment for programming and problem solving.

There follows a brief explanation of each of the categories in Zinn's classification.

(i) *Description of successive frames or items*

These programming languages favor the presentation of successive items which might be pieces of information, questions, comments and so forth.

In addition to being conversational they may be distinguished from other programming languages by the facilities offered:

- for presentation of texts
- for correcting open answers (which are not chosen from a given set)
- for automatic recording of the students' answers and the state of numerous counters and cells for each answer
- for implicit branching determined by an answer of the contents of a set of counters.

Zinn lists twenty-four such languages (45). Two of the main ones, "Coursewriter" and "TUTOR", are used in Québec.

2.1.4 ...

These languages have been influenced by programmed instruction and their structure results from this type of teaching. They have two disadvantages.

- first, the user (teacher or pupil) receives little calculating capacity and often, little room is left for student initiative. It is mainly through his answers that the student can interact with the machine.

- second, although the languages are meant as tools to help the teacher program his courses, any one who is not a data processing expert has difficulty using them as is shown by the number of auxiliary systems for these languages designed to help the teacher program or to enable him to avoid programming. The work done by Robert Brien (7) of the Laboratoire de Pédagogie Informatique may be referred to on this point.

(ii) *Provision for conversation within a limited context.*

The limitations of the first category of languages in student-machine exchanges incited several authors to create a new language or modify their own in order to give it greater flexibility in dialogue or, in some cases, to simulate a conversation between the student and the program (always within a very limited context). Generally, these languages

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* IBM has also provided one of its teaching languages (a new improved version of Coursewriter: ITS (Interactive Training System) with a system making it possible to avoid programming if so desired.

2.1.4 ...

already possess the characteristics of frame languages.

Zinn lists seven languages in this group: FIT, ELIZA, FOIL, MENTOR, MINORCA, GLURP and PLANIT. The last four were already included in the frame language category. At the Laboratoire de Pédagogie Informatique, a team used sentence analysis to improve "Coursewriter" in this way, enabling students to give open answers and even ask the computer questions. (34-35)

Research done in this area is very interesting and tackles the basic problem man-machine interface. There are two possibilities: either we use machine language or the machine uses a language increasingly similar to natural language.

It must of course be noted that the second possibility has so far prevailed. There seems in fact, to be a constant evolution towards natural language. Research is even being done on voice recognition and artificial voice reproduction.

Some of the languages listed above simulate a real dialogue between the student and the computer. In fact, they can use a data basis which forms a complex semantic network of facts and concepts grouped by meaning and interrelation.

2.1.4 ...

With sentence construction and recognition structures, these languages make conversation with the student possible. The conversation, of course, is always within the context of the computer's semantic network.

Before the third category in Zinn's classification is discussed, certain characterisitics common to the languages of categories (i) and (ii) should be pointed out.

They were all developed especially for the authors of computer based courses; this is why Frye groups them under the heading "author languages" (22). With reference to the classification of the instructional uses of the computer given in Volume I of this report, it may be noted that all these languages are used mainly for *teaching instrument* applications. They are also used in several conversational applications where the computer is employed as an *instructional management tool*. These were the languages that led to research on the instructional uses of the computer (1960), and their popularity grew continually as proven by their number. Many instructional programs were written and the different authors grew aware of the considerable amount of time required to produce valid instructional material.

2.1.4 ...

This time factor certainly slowed down program development particularly for *tutorial* instruction. Preparation time is shorter for *drill and practice* programs where one procedure can generate a very large number of similar problems. Note that the concensus which is gradually being reached on the use of educational objectives will make it easier to write instructional programs. We believe the development of the third category of languages cited by Karl Zinn is characteristic of this movement.

To the languages Zinn places in this third category, we would add instructional management procedures which are not necessarily carried out in the conversational mode.

(iii) *Description of a standard procedure by which material is presented.*

Several of the languages in this category grew out of an endeavor to reduce preparation time for instructional material used with the computer. Standard procedures for presenting material or giving exercises are thus available to the teacher. In other cases, one procedure may be used to generate a quantity of similar problems. These systems are often extensions of common data processing languages. The CAIO system (Illinois) and the XXX system (University of Minnesota), for instance, both derive from FORTRAN. Université Laval, has a similar system, PICO, which uses APL and was developed at the Institut de recherche en informatique et automatique (IRIA) in France (7).

2.1.4 ...

The instructional functions carried out by these procedures are preset for the user, whereas with category (i) and (ii) languages, the user generally establishes his own procedures. This is why the word "system" is used here, a generic term broader than "language".

The many instructional management systems which appeared after the author languages can consequently be included in the third category. The idea behind the creation of each of these systems is individualized instruction. The systems are not necessarily in the conversational mode. In fact, with most there is no real-time interaction between the student and the computer. With reference to the classification of the instructional uses of the computer proposed in Volume I of this report, it may be noted that the systems in this third category are generally used for *instructional management tool* applications. Their main functions are to correct tests, interpret needs, determine progress and analyze results.

The first of these systems was developed in 1968 by "Systems Development Corporation" in Los Angeles. In 1971, Baker (4) analyzed six important systems in this category, including:

2.1.4 ...

- IMS (Information and Management Systems) developed by Silberman (1968) at the SDC (System Development Corporation).

- IPI/MIS (Individually Prescribed Instruction) developed by Glaser (1968) at the Pittsburg Research and Development Center.

- PLAN (Program for Learning in Accordance with Needs) developed by the Westinghouse Learning Corporation.

- TIPS (Teaching Information Processing System) developed by Kelly at the University of Wisconsin.

(iv) *Specification of an environment for programming and problem solving.*

The first three language categories are often related to those theories of behavioral psychology of which Skinner, for one, is a strong defender. These languages are used mainly for teaching. Another school of thought which is extremely influential today, emphasizes learning. The theorists of the active "Learning by doing" school are very characteristic of this movement. This attitude is also found in instructional applications made possible by the languages in the fourth category of Zinn's classification.

Some of the languages in the fourth category were not intended for teaching but were almost immediatly used to this end upon their appearance in 1964/65. Zinn lists some twenty languages in this group, only ten of which,

2.1.4 ...

including BASIC*, LOGO, PIL, and LSE **, were developed especially for instructional purposes.

These languages, especially BASIC and LOGO, are generally very easy to use, even for novices. LOGO, moreover, may even be used for some applications by elementary school pupils.

Each of these languages enables the student to program the computer for problem solving in the conversational mode. In other words, the student gives his instructions and data directly to the computer through a console equipped with a typewriter. The computer gives an immediate answer. A direct conversation is then possible between the user and the data processing system. Hence the term "conversational" to characterize these languages.

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* BASIC, the first interactive language created for instructional purposes, was perfected in 1966 at Dartmouth College in the United States.

** This language was developed by a team from the Ecole d'électricité de Paris (26).

2.1.4 ...

These languages are particularly useful since they enable the user to receive an immediate answer from the system. The importance psychologists attach to immediate communication of results in the learning process is well known. These languages also make possible a large number of applications in which interaction between the user and the computer is absolutely necessary as in certain simulations where the user must continuously furnish data as the program is being carried out.

(c) Language popularity

Figure 8 is a histogram of the relative usage given each language. It is based on the University of Wisconsin index (26). APL, BASIC and CWII are used in approximately the same number of programs.

Two successive editions of the index reveal a very rapid growth in the popularity of APL: 18 programs in 1970 and 230 in 1971. APL is used increasingly in universities. Its logical mathematical character and its computing power make it a precious instrument for advanced work.

The number of programs is not the only criterion for judging a language's popularity; the duration of the programs is also indicative. The histogram in figure 9 uses this second criterion. IBM's Coursewriter II is used for

2.1.4 ...

the greatest length of time, followed by TUTOR, BASIC and Coursewriter III in that order. The average length of the programs described in the University of Wisconsin index is 11.5 hours for TUTOR, 5 hours for Coursewriter II, 2.7 hours for BASIC and .75 hours for APL.

2.1.5 Course programs

Two different sources describe programs which use the computer for instructional purposes. The first is the ENTELEK guide with about 500 programs. The second, the University of Wisconsin index, is more complete. The 1971 edition described 1300 programs, the 1972, edition will give almost 1800, most of which can be obtained from the institutions which created them. Program libraries do not yet exist but programs should become increasingly available through the facilities offered by computer networks.

More and more program exchange groups are being formed. Such a move is often the first step in setting up a network.

At least one company markets computer-assisted

2.1.5 ...

instruction programs - the Sterling Institute in Boston*. Moreover, along with their conversational systems, time-sharing companies provide or sell access to a certain number of educational programs.

At present, course programs are almost all independent of each other. Most, in fact, were not set up within a given curriculum but rather to attain a specific objective: to simulate a particular phenomenon in physics, or teach fundamental operations, for example. Generally speaking, they are set up by one person or a small group of persons. Even though the different kinds of computer material are often incompatible, existing programs nevertheless provide a rich source of inspiration for authors of new programs. A program bank, can be used as a bank of ideas easily tapped.

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* Hewlett-Packard has commercialized Suppes' elementary mathematics program, using small 2000 Series computers.

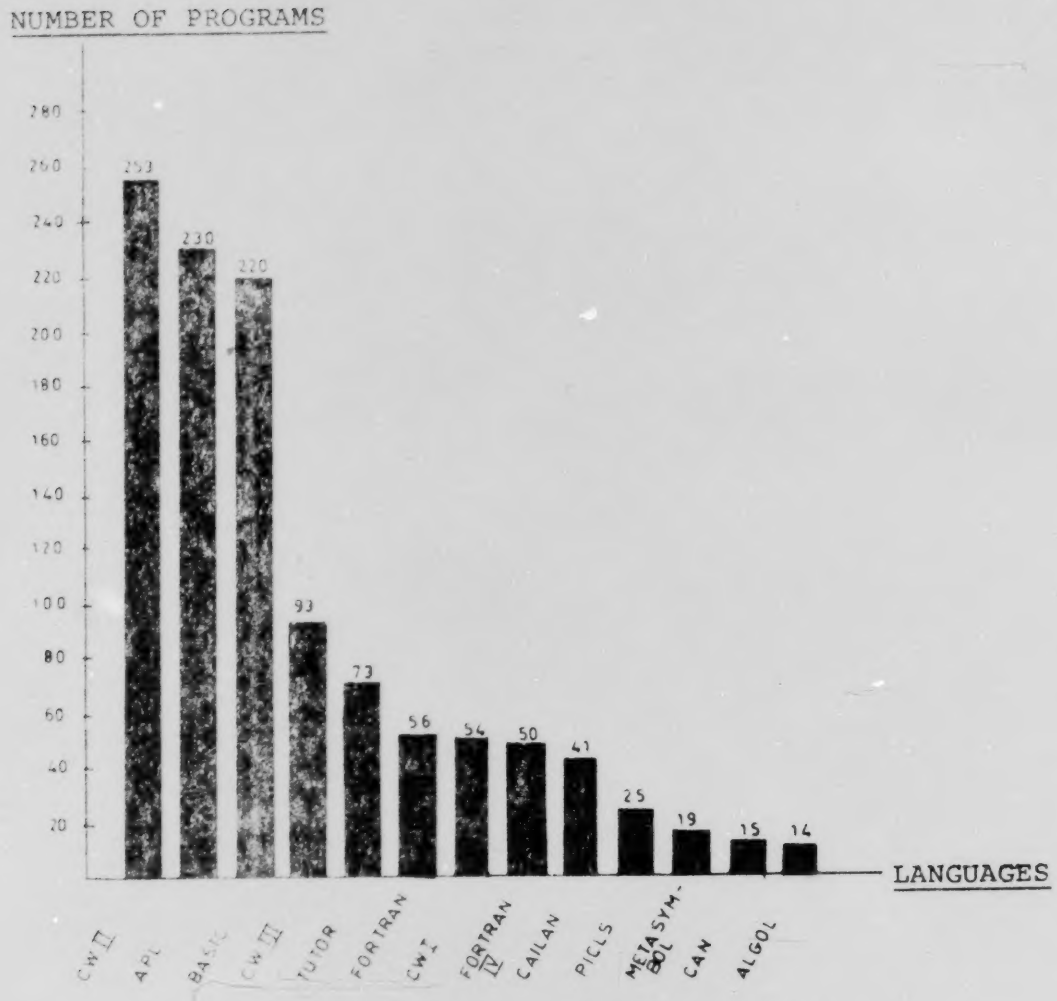

Fig 8 Number of programs written in each language.

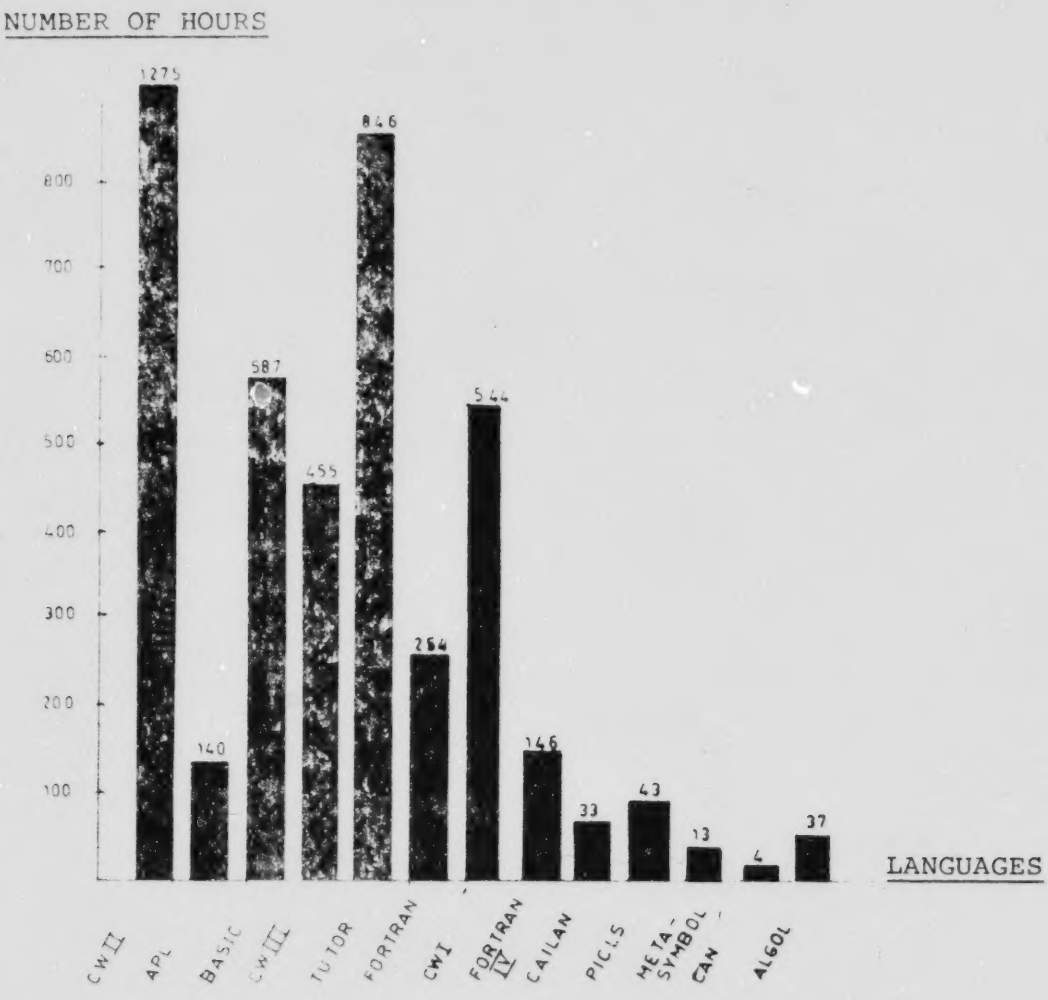

Fig 9 Total duration of programs written in each language.

2.2 Instructional use of the computer

2.2.1 Introduction

We will endeavor here to demonstrate the scope of the instructional uses of the computer. To this end, we have gathered a certain amount of information but there is much more. In the United States* in particular, where the phenomenon is far more advanced than elsewhere, the scope of the instructional use of the computer deserves to be the subject of an exhaustive study.

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* Appendix A, a table presenting various projects for the instructional use of the computer, is based on information taken from *Automated Education Letter*, 1970 and 1971. We did not find any recent public report on the subject for the United States and have every reason to believe that none exists. The decentralization of the American educational system would make it difficult to keep reliable statistics on the instructional use of the computer. Moreover, the various American army corps are responsible for much of the research and many of the applications and the army is discreet about its work.

2.2.1 ...

We nevertheless thought a few general remarks based on available data should be made regarding the present rate of use of the computer for instructional purposes, the methods of use and the subjects or levels of application. In some cases, we were reduced to making hypotheses which we point out.

In dealing with the scope of the instructional use of the computer, we will distinguish between each of the categories proposed in the first volume of this report. For each category, *laboratory tool*, *instructional management tool*, and *teaching instrument*, we will give

(a) its use in Québec,

(b) its use in the other provinces of Canada,

(c) its use in the United States,

(d) its use in Europe (particularly in France).

2.2.2 Use of the computer as a *laboratory tool*

The following uses are included in this category: *electronic equipment*, *calculator*, *automaton*, *simulator* and *research and development tool*.

(a) In Québec *(laboratory tool)*

In Québec the computer is used above all as an *automaton*. Each university has a data processing center and the students generally use the computer in this mode. In fact, most faculties incorporate into their program courses in data processing, in which the student is required to program the computer in order to solve certain problems. These courses are sometimes compulsory.

In addition, the university data processing centers usually make a conversational system available to faculty and students. At Université Laval, for instance, the APL system has been available since 1968. A large number of students can use this system at one time or another in their course to learn data processing or solve problems or while engaged in research. Some sixty people can use the system simultaneously.

At the college level, too, the computer is usually used as an *automaton*. Vocational students, specializing in data processing regularly use the computer as an *automaton* within the framework of their course. In general as well as vocational courses, more and more departments are introducing one or two optional or even compulsory data processing courses. The popularity of these courses among non-specialists

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is growing as people become aware of the increasing importance of data processing in the work students intend to do.

Every college has its own data processing center. The Department of Education's Data Processing Service deals with several thousand student programs every day. In several colleges, departments also use desk calculators and minicomputers for special purposes. Students are often able to use these machines in their courses.

In July 1971, the Department of Education's Data Processing Service made a conversational system available to certain bodies*. Several colleges are experimenting with this system, mainly for computer *automaton* and *calculation*. Eight M.C.S.C. high schools use this system in the Secondary III mathematics course.

The report of the conference on the instructional use of the computer held in May 1972 describes several experiments on the computer as a *laboratory tool* (30), most of which were

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* This is an ITF system (Interactive Terminal Facilities) offering the interactive languages BASIC and PL/1. A maximum of 31 users can work with it simultaneously.

2.2.2 ...

carried out in Québec by college teachers. It is to be hoped that progressively, teachers in different disciplines will be able to become familiar with data processing and the instructional possibilities of the computer. At present, the computer is generally used to teach data processing but it will probably be applied gradually to other subjects. The computer will thus become a common instructional tool, its generalization favored since it can be used in the conversational mode.

Increasingly, data processing services are making application programs available to teachers and students. Several of these programs have a definite educational interest. Teacher participation in the development of such programs would probably promote computer laboratory uses which, in turn, would stimulate computer calculation and simulation. Appendix B gives a list of the programs contained in the common ITF library, programs which in February 1973 became available to anyone using this conversational* system.

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* It would be in Québec's interest to develop exchange systems so that it could create a bank containing all the instructional application programs of a quality to rival those developed in other countries.

2.2.2 ...

(b) In the United States *(laboratory tool)*

Used as an *automaton* to teach data processing, the computer has reached about the same point in universities and colleges in the United States as in Québec. Most such institutions use it for this purpose. In colleges and high schools; however, conversational applications as a *laboratory tool* are more advanced in the United States than in this province. In fact this type of use was and is increasingly popular (as proven by the number of conversational languages available). Its popularity is easily understood in view of the advantages of the conversational mode for teaching data processing, learning logical and algorithmic processes, solving problems and so forth.

It is not easy to judge the extent of the phenomenon. The exact number of schools and colleges using conversational systems is unknown. The number of companies which sell or rent such systems (particularly BASIC which is available on almost all small and medium-sized computers), clearly

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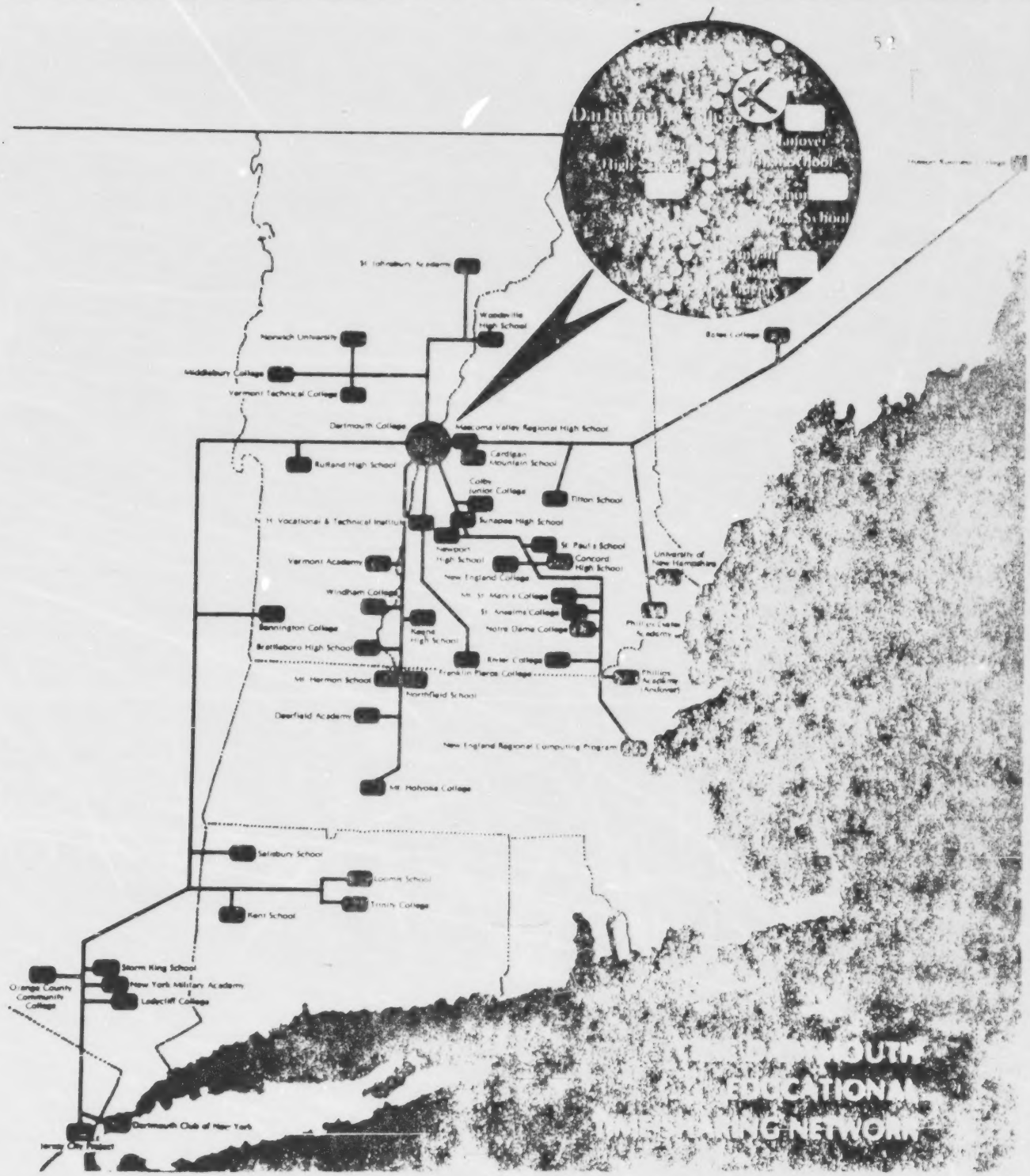
* It should be mentioned at this point that data processing as a discipline in colleges and universities was introduced earlier in the United States than in Québec. It is therefore natural to find a greater number of American teachers who, being already familiar with computers, use them as a teaching instrument.

2.2.2 ...

indicates that the market is an expanding one. A large proportion of college and university students in the scientific disciplines use the conversational mode at one point or another of their course.

Dartmouth College in the United States has been promoting these systems. In 1966, it became the first institution to develop a conversational system for teaching purposes. Its network of users is now very large. (cf. Fig. 10)


Dartmouth College
Hanover High School
Hanover Junior High School
Hanover Elementary School
Hanover Consolidated Schools

2.2.2 ...

(c) In France *(laboratory tool)*

France's policy as regards the development of data processing has been established for some years (31). It is called *Calcul* (18). The principal role of the data processing official in charge of *Calcul* involves promotion

- of the French data processing industry,
- of the use of data processing,
- of training in data processing.

This general set up favored the definition of a policy for developing the instructional uses of the computer. On the secondary level, the use of the computer as a *laboratory tool* is encouraged. Generally speaking, this policy does not recommend data processing as a distinct discipline at the secondary level but rather that it be taught within the framework of other disciplines.

This policy has already been implemented in a development project and a training program for teachers has been in effect for three years. Moreover, an interactive instructional language, LSE, has been developed at the Ecole supérieure d'électricité de Paris, under contract to the Délégation à l'informatique.

LSE is now operational on Cie Télémécanique and

2.2.2 ...

Cii minicomputers. Since the fall of 1972 four lycées have been operating a small conversational system with eight terminals for each school. In three years time, several French lycées should possess similar equipment, since by then, a considerable number of teachers will have been trained in the use of this new technique. Supposing that each session at the terminal lasts an average of thirty minutes, every day 150 students will be able to use the system as a *calculator*, an *automaton* or a *simulator*.

The initiative for the use to which the computer will be put in a course is the teacher's. It is hoped that with a computer at their disposal, students will develop skill in the algorithmic solution of problems. The work done by the Office français des techniques modernes d'éducation (OFRATEME*) which is preparing computer simulations in various disciplines (physics, mathematics, and so forth) should also be noted. These simulations will be made available to schools.

Finally, the French policy on teaching data processing at the secondary level is along the same lines as that developed by CERI**(Centre for Educational Research and Innovation) (9).

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* Québec might consider cooperating with OFRATEME, especially in exchanging application programs.

** CERI is an OECD task force.

2.2.2 ...

(d) In the other provinces of Canada *(laboratory tool)*

The other provinces of Canada also use the computer as an *automaton* for teaching data processing. It is, in fact, generally agreed that the most effective way of learning to program is to program a computer oneself. It should be mentioned, however, that in this field, Québec has a clear advantage in the quality and quantity of the data processing services available to students and teachers. In fact, the existing network enables students in the Gaspé Peninsula or Thetford Mines to enjoy the same services as students in Québec or Montréal.

The computer is used in the conversational mode principally in university centers. For instance, APL is available at the University of Alberta and Simon Fraser University. At the University of Calgary BASIC is used. Canadian centers, however, are more interested in using the computer as a *teaching instrument*.

2.2.3 Use of the computer as an *instructional management tool*

This category groups *information banks, answer processing, test generation, individualized testing* and *computer-managed instruction*.

2.2.3 ...

(a) In Québec (*instructional management tool*)

The computer is quite often used in Québec for correcting and marking students' examinations. At the present time, however, it is not much used for instructional management as such, to help students and teachers, or for managing learning activities. A few local experiments on this type of use are nevertheless being carried out, some of which are mentioned in the report on the May 1972 conference (30). Six of the thirty-six papers presented during the conference dealt with the use of the computer as an *instructional management tool*.

A test generation system was developed in 1971 at the Ecole polytechnique in Montréal. In January 1972, this system became operational and was tested on a group of three hundred students in a mechanics course. Each student could choose when he wished to be tested on a section of the course. During the semester, the computer prepared and corrected 8,000 different questionnaires based on a bank of 1,000 questions (29).

Some college teachers are using SIMEQ's ITF system. In the Physics Department of Bois-de-Boulogne college, for instance, an experiment subsidized by the College Education Branch continues work on test generation

2.2.3 ...

and correction which was begun at the college two years ago. This year the aim is to determine the advantages of the conversational mode. Using the ITF system, series of questionnaires are made available to the student enabling him to increase his skill in physics and check his progress. As he solves the problems, the student feeds his answers to the computer. He immediately receives assistance, the solution to the problem or an appropriate comment, as required. The experiment is being carried out with two classes taking two different physics courses. Mr. Leduc, who is in charge of the project, agreed to make his system (question banks and support programs) available to other colleges through the common ITF library. Other ITF users, the Trois-Rivières and Shawinigan CEGEP's in particular, are in fact interested in this type of computer use.

It should be pointed out in passing that the common ITF library is itself a bank of educational programs. It contains, among others, a *computer-managed* course, ITF/PL/1, developed in the Laboratoire de Pédagogie Informatique.

It must be noted that before the computer can be used as an *instructional management tool* a considerable amount of work is required from a pedagogical point of view. Only those teachers who have based their programs on objectives are really ready to use the computer for this purpose.

2.2.3 ...

(b) In the United States *(instructional management tool)*

This is the field of application in which the greatest advances are being made in the United States because of the increasing use of the system approach.

At this point, the three distinct stages characteristic of this approach should be recalled:

- choice of objectives to be sought,
- search for most effective method of reaching the objectives,
- evaluation of quality or performance.

It may easily be believed that the generalization of this process will lead to very notable changes in education. Several education management systems have resulted from this new trend. The computer's role is of primary importance within these systems, either for defining, developing, executing or controlling the operation of the system itself.

Several examples may be cited. The 1971-72 *Automated Education Letter* reports several new uses for *information banks* in counselling, reference banks (computerized documentation) and library management for teachers and students. There are many

2.2.3 ...

question bank management systems*.

It should also be noted that there are several systems for *instructional management*. Last year, the Westinghouse Learning Corporation's PLAN system, for instance, involved 30,000 pupils in 79 schools. (The system is most popular at the elementary level). The following is a list of the main research centers interested in *instructional management*.

CENTER	LOCATION	DIRECTOR
Southwest Regional Educational Laboratory	Los Angeles	Henry Silberman
University of Pittsburg	Oakleaf School in Pennsylvania	Robert Glaser
Sterling Research Corporation	Boston	Donald Torr
Institute of Technology & U.S. Naval Academy	New York	Alexander Shure
Westinghouse Learning Corporation		Don Tosti

*The Laboratoire de Pédagogie Informatique, for instance, has CTSS.

2.2.3 ...

(c) In Europe (*instructional management tool*)

Very few French research centers are interested in this type of computer use. During visits to several French centers last November, we came across only one concerned with this application: Professor Le Corre's center in Paris (11) where experiments on *individualized testing* are carried out.

There is also a team at the University of Louvain in Belgium doing research on the computer used as an *instructional management tool* at the university level (12).

Both of these centers belong to CERI* (Centre for Educational Research and Innovation) which is responsible for defining a policy on computer use in higher education.

2.2.4 Use of the computer as *teaching instrument*

(a) In Québec (*teaching instrument*)

In Québec, experiments in which the computer is used as a *teaching instrument* are rather limited. More or less isolated researchers are experimenting with it, mainly on the university level.

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* CERI is an OECD group.

2.2.4 ...

The author language, MULE (McGill University Language for Education), has been developed at McGill University (40). The University of Québec offers TUTOR to its teachers and Université Laval has just begun using Coursewriter III. The CIT/CAN language (a version of CAN, a language of the Ontario Institute for Studies in Education) is used at Sir George Williams University.

The Laboratoire de Pédagogie Informatique uses the computer as a *teaching instrument*. The most advanced technique is the *tutorial* mode in which several courses in mathematics, electronics, data processing, French, geography and so forth have been developed.

It should also be mentioned that the first *tutorial* course developed in Québec is still operational. This course, initiating students to the use of APL, has been applied extensively. At the Université Laval, some faculties actually suggest that their students take it within the framework of a regular course. Easy access to the course is definitely one of the reasons for this popularity. In fact, anyone using the system can go to the terminal and request the course at any moment of the day or night. The author of the course* sees this accessability as one of the major advantages of future computerized educational material.

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* William Lee, the director of the Laboratoire de Pédagogie Informatique.

2.2.4 ...

(b) In France *(teaching instrument)*

The French policy is far less definite for this type of use than for the use as a *laboratory tool*. France does not seem to be ready to encourage the development of such applications but rather appears particularly sensitive to the difficulty of making projects in this field operational once the research stage is terminated. An author language, MAGISTER has nevertheless been developed at the Université dc Grenoble.

(c) In the United States *(teaching instrument)*

This type of computer use is more highly developed in the United States than in any other country. Several research centers have already made their projects operational. Figures 11,12 and 13, based on data taken from the University of Wisconsin index* represent various trends in this field in the United States.

(i) Rate of use

We do not have the exact number of American centers which use the computer as a *teaching instrument*. The

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* This index describes course programs written in the conversational mode. The classification used is not the classification of the instructional uses of the computer presented in Volume I of this report.

2.2.4 ...

University of Wisconsin index lists 150 centers which develop programs. On the basis of estimates of the number of existing centers, the number of terminals available in each center and the number of hours of use (250 centers, 30 terminals per center, 8 hours a day) it may be concluded that about 150,000 students could use the computer for half an hour every day. Although this seems quite a considerable number (and the actual figure is probably yet greater), it only represents a small proportion of the American school enrollment (52,000,000).

The use of the computer as a *teaching instrument* is therefore far from generalized in the United States. Several authors point out that predictions on development made after the first experiments have not come true. The tendency has, in fact, been more towards *computer managed instruction* and *laboratory tool* applications.

(ii) Comparison of the types of computer use, the subjects and levels involved, in relation to the number of programs written.

Figure 11 shows the relative popularity of the various types of computer use. The greatest proportion of written programs are for the *tutorial* mode (42%). Following far behind comes *drill and practice* with 17.8% of the applications.

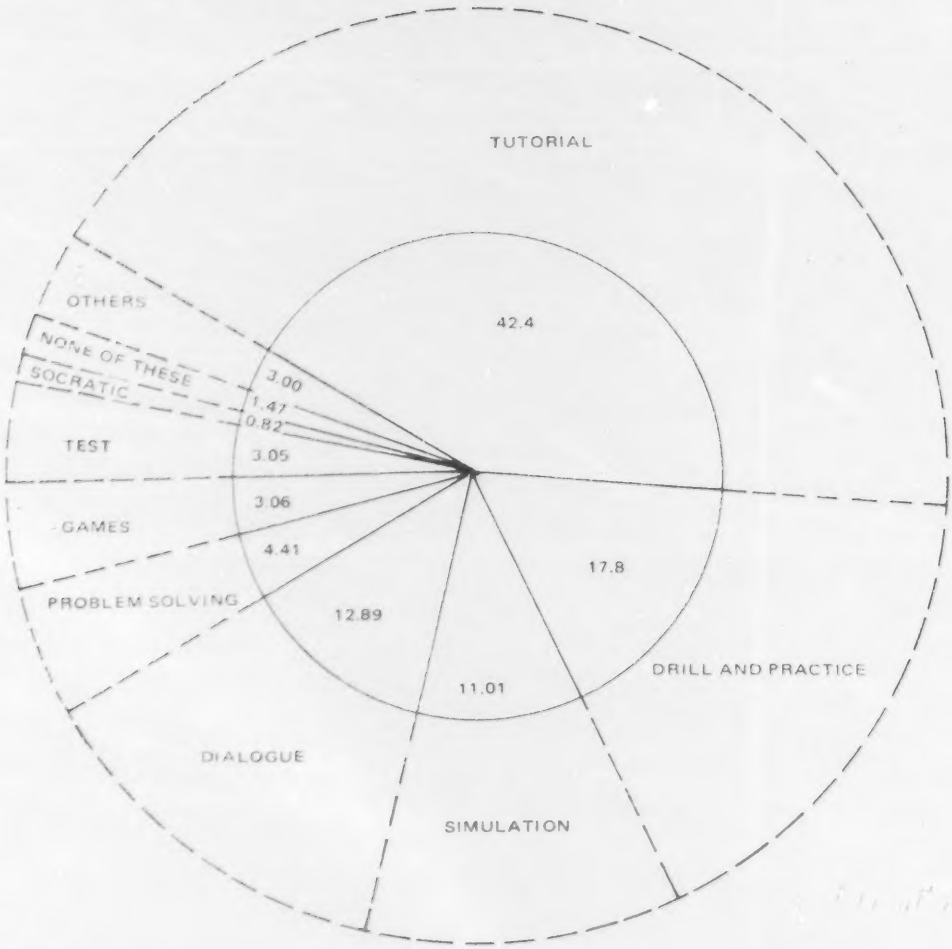

FIG. 11 *Programs described by the University of Wisconsin index (1971), by program logic.*

2.2.4 ...

These are all conversational programs.

Figure 12 indicates the proportion of programs intended for the various levels of instruction. The secondary level has the most with 34 percent; college level follows with 25 percent. The large proportion of programs available for the secondary level as compared to the university level is an indication of the point to which CAI projects are operational in schools.

With reference to the subjects taught, it may be said that in general, computers are best adapted to instruction in the exact sciences. As shown in Figure 13, 33 percent of the programs are used to teach mathematics, 20 percent, physical sciences (physics, chemistry, biology) and only 10 percent are used to teach data processing.

(d) In the other provinces of Canada (*teaching instrument*)

The Canadian university centers are very interested in the use of the computer, particularly as a *teaching instrument*. Several universities have centers for research in this field. In some cases, as at Simon Fraser University, work has reached the operational stage.

FIG. 12 Programs described by the University of Wisconsin index (1971), by the level of instruction

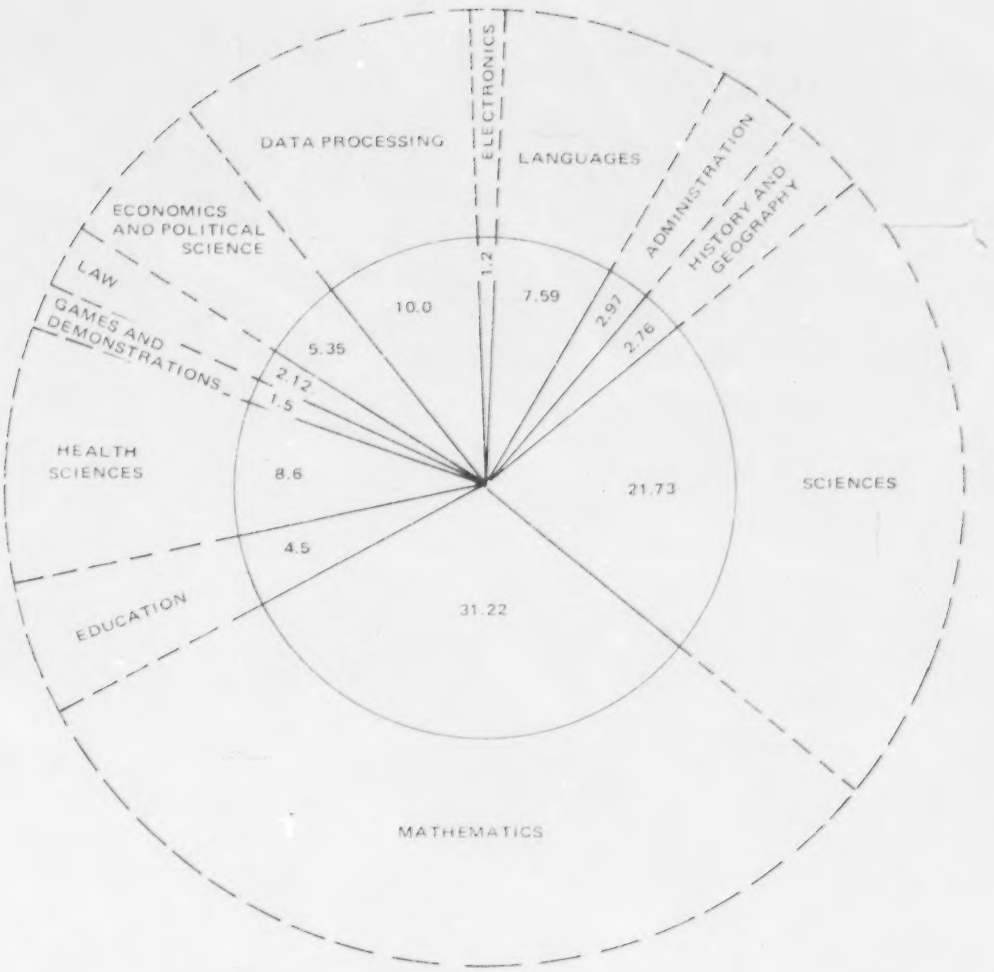

FIG. 13 *Programs described by the University of Wisconsin index (1971), by subject*

2.2.4 ...

The Associate Committee on Instructional Technology* (ACIT) has formed a Subcommittee to set up a Canadian instructional programming language. Such a language would facilitate the exchange of CAI software between the various centers (13). The subcommittee is made up of specialists from all over Canada**.

Last May, the National Research Council of Canada organized a conference on educational technology. The following table is based on information taken from the conference reports (16) and gives a brief description of the work of the Canadian research centers using the computer as a *teaching instrument*.

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* This committee was set up by the National Research Council.

** The Québec Department of Education's Data Processing Service is represented by François Labrousse, a member of the Laboratoire de Pédagogie Informatique.

Center	Language	Computer	Population	Subject	Use
University of Alberta	Coursewriter II	IBM 1500	University	Medecine	Tutorial
Simon Fraser University	Coursewriter III	IBM 360	University	Chemistry	Tutorial
University of Calgary	Focal basic	PDP-8	Primary secondary university	English mathematics guidance physics	Drill and practice tutorial simulation
University of Toronto	APL	IBM 360			Tutorial
University of Western Ontario	ETL basic can	PDP-10	Elementary secondary	Mathematics Data processing languages	Tutorial dialogue simulation
Ontario institute for studies in education (OISE)	Can	PDP-9 PDP-10	7 elementary and secondary schools	Mathematics	
National research council	Development of hardware and software goal - cooperation				

CHAPTER 3

ASSOCIATIONS FOR COOPERATION AND EXCHANGE

Centers using computers for instructional purposes have joined in a large number of associations. Generally, the main objective of these associations is to promote cooperation among members and the exchange of information and work.

3.1 User associations

These associations bring together the users of one system or of the systems of one company. In the field of instructional applications, the following associations should be noted: Hewlett Packard, Educational Users Groups, ADIS*. Every month each of these associations publishes a journal or an information sheet for its members.

3.2 Professional associations

Some professional associations have formed subgroups of those members who are interested in the instructional uses of the computer.

One of the most important associations of this type is the ACM (Association for Computing Machinery). Founded in 1947, it comprises some 200 institutions including

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* ADIS (Association for Development of Instructional Systems) groups users of IbM products in particular.

3.2 ...

at least 150 universities throughout the world. The objectives of the ACM are to further the science of data processing and promote free exchanges of information among the members of that discipline (36). Other professional associations such as the IFIP* (International Federation of Information Processing) have, like the ACM, an international character.

The ACM includes the subgroups SIGCSE (Computer Science Education) and SIGCUE (Computer Uses in Education). Each of these subgroups publishes a quarterly news bulletin and regularly organizes seminars and conferences.

Other groups, which are independent, are also interested in the use of the computer in education, as, for instance, the AEDS (Association for Educational Data Systems), the AECT (Association for Educational Communication and Technology), and the NSPI (National Society for Programmed Instruction). In cooperation with S.A.L.T. (Society for Applied Learning Technology), these three groups organized a conference in February 1973: *The Cost-Effective Learning Through The Application of Computer Technology.*

Groups have also been formed in the various

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* For a description of the activities of this association in the educational field, refer to the British Computer Society's *Educational Yearbook*, 1972/73 (8).

3.2 ...

disciplines. The aim of the GPE (Geography Program Exchange) is the exchange of CAI programs in geography. CACHE (Computer Aids for Chemical Engineering Education) has a similar objective.

3.3 Information associations

These are organizations such as ERIC and ENTELEK whose primary role is to class and distribute data.

(a) ERIC (Educational Resources Information Center)

ERIC is a monthly journal which publishes abstracts of reports on recent research in education. It is put out by the US Department of Health, Education and Welfare-National Institute of Education. ERIC notes the availability of the documents described, several of which can be obtained on microfiche. ERIC is an invaluable source of information on the instructional use of the computer.

(b) ENTELEK

Since 1965, ENTELEK, under contract to the American Office of Naval Research has set up an information exchange system for computer-assisted instruction (21). The groups

3.3 ...

objectives are:

- the preparation and distribution of abstract research, descriptions of available programs and of research center activities.

- the organization of conferences, symposiums or seminars on computer-assisted instruction.

A person subscribing to the ENTELEK system regularly receives index cards describing the research, programs or activities of other centers.*

3.4 National Organizations

In several countries, there are national organizations actively concerned with the instructional applications of the computer. In France, a group of researchers of the IRIA (Institut de recherche en informatique et automatique) (28) is involved in defining instructional systems. Work is also being done in France at OFRATEME (Office français des techniques modernes d'éducation**) to develop computer simulation programs. In Canada, a group from the

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* Every year ENTELEK gives on-the-job CAI training in four or five different cities in succession.

** OFRATEME publishes the educational magazine *Media*.

3.4 ...

National Research Council in association with several university people is engaged in research on the terminals and languages used in education.

Because of their national character, these bodies are expected to provide information and cooperation in this field. For instance, an information system on the instructional use of the computer was set up by the IRIA; the National Research Council of Canada has formed a group of specialists to develop a Canadian instructional language.

3.5 Computer networks

In some cases, computer networks (which have already been discussed in section 2.1.3) form nation-wide exchange organizations. Some of these networks will be reviewed here. In Québec there is the network set up by the Data Processing Service of the Department of Education (30 colleges and 30 school boards). The University of Québec is also developing a network of this type for its members.

The Ontario universities are in the process of organizing a network linking their processing centers (17). On the national scale, the CANUNET network will group about fifteen participating institutions. Computer networks for educational purposes may also be found in the United States, for instance:

3.5 ...

MERIT (Michigan Educational Research Information Triad) grouping three universities,

CCN (UCLA Campus Computing Network) linking 19 state colleges and one university,

EIN (Educational Information Network) grouping 70 universities,

TIES (Total Information for Educational Systems) grouping 29 school districts.

3.6 International organizations

Several international organizations (the ACM and the IFIP are international in scope) are interested in the instructional uses of the computer, for example, UNESCO and the OECD (Organization for Economic Cooperation and Development). In 1968 the OECD to which Canada belongs, set up a Center for Educational Research and Innovation (CERI). One of CERI's goals has to do with educational technology and program development. In 1971, two projects dealt with the instructional use of the computer. The first involved instruction in data processing at the secondary level (9), the second, the use of computers in higher education (10).

3.7 Conclusion

It was our intention to name a few organizations or associations interested in the instructional use of the computer, but not to draw up an exhaustive list. Rather, we wished above all to show that a vast move toward cooperation and exchange has begun in this field of research and implementation and this cooperation would seem to lead to higher quality. The problems raised by system incompatibility are not unrelated to the development of this new spirit.

APPENDIX A

This table is based on data taken from *Automated Education Letter*, 1970-71 and presents various projects for the instructional use of the computer in the United States.

Project	Level	Clientele	Subject	Strategy	Schools	Terminals	Stage
Indicom Detroit March 1970	Secondary		Languages mathematics	Teaching instrument		32	Operational
Impact (Humbro) Alexandria April 1970							Research
The Muscatine Scott School system Dettendorf April 1970	Secondary			Laboratory tool	10	24	Operational
Oakland May 1970	Elementary	Under-privileged	Mathematics	Test generation	42	42	Operational
Bowdoin college Brunswick May 1970	College high-school					5	
Akron Ohio May 1970	Secondary					24	Operational
Stanford University Palo-Alto May 1970	Primary	5000/day	Mathematics	Drill and practice	60	200	
Colorado June 1970	Secondary elementary					48	Operational
Gavilan College Gilroy California	College high-school	150/day	Sciences	Teaching instrument			Operational
University of Alabama Dec. 1970	University			Laboratory tool		21	Operational
Dartmouth time-sharing-system Dartmouth Dec. 1970	All	15000/yr		Laboratory tool	57	150	Operational

Project	Level	Clientele	Subject	Strategy	Schools	Terminals	Stage
Diss Hatfielt England Dec. 1971	Secondary college			Laboratory tool	17	50	Operational
Ties (computer coop) Jan. 1971	1 - 12					70	Operational
University of Pennsylvania Feb. 1971	Adult	Professors 1000/yr	Psychology	Teaching instrument		15	Operational
Region IV Educational service center Houston Feb. 1971		200,000/yr		Teaching instrument	225	225	Operational
Ohio state university Feb. 1971		4000/day		Laboratory tool		400	Operational
U.S. Naval Academy Annapolis May 1971		Military				125	Operational
Dartmouth college May 1971	College				60	192	Operational
Eastern Kentucky Educational Development Corporation July 1971	Primary	2000/yr	Mathematics	Drill and practice	26	34	Operational
Illinois institute of technology Chicago Sept. 1971	Secondary college university			Laboratory tool	50	50	Operational

Project	Level	Clientele	Subject	Strategy	Schools	Terminals	Stage
Willis Booth Computing Center Pasadena California sept. 1971	College University			Teaching instrument and laboratory tool	10 colleges	64	Operational
Huntington Computer project. nov. 1971	College		Biology physics social sciences	Laboratory tool simulation	45		Operational

APPENDIX B

DESCRIPTION OF THE COMMON ITF LIBRARY

IN JANUARY 1973

100 - General

INF	PL/1	Programme d'information générale.
LST	PL/1	Description des programmes de la librairie commune.

100 - Biology

PGF	PL/1	Description et fonctionnement du coeur.
V06	PL/1	Test du cours sur le coeur, suite de PGF.
PN#	BASIC	Expérience de photosynthèse.

120 - Chemistry

BOR	PL/1	Etude de l'atome de Bohr.
TAB	BASIC	Table de conversion du pourcentage de transmutance en absorbance.
MD#	BASIC	Calcul du défaut de masse dans un atome.
NC#	BASIC	Simulation sur la vitesse de réaction des enzymes.
KT#	BASIC	Programme sur les équilibres chimiques.

130 - French

VRB	PL/1	Analyse des formes verbales en français.

140 - Data Processing

INT CCC ↓ CCK	PL/1	Tests du cours ITF:PL/1

150 - Mathematics

CRB	PL/1	Trace une courbe point par point.
POL	PL/1	Interpolation d'une courbe par un polynôme.
FR#	BASIC	Calcul des facteurs premiers d'un entier.
LD#	BASIC	Calcul du PGCD de deux entiers.
DV#	BASIC	Calcul de la dérivée d'une fonction et un point.
IT#	BASIC	Calcul de l'intégrale d'une fonction.
VL#	BASIC	Volume d'un solide de révolution.
D1#	BASIC	Equation différentielle de premier ordre.
D2#	BASIC	Equation différentielle de deuxième ordre.
SC#	BASIC	Calcul de l'aire d'une surface de révolution.
CN#	BASIC	Calcul de la longueur d'une courbe plane.
LUC	PL/1	Transformation d'une base à une autre.
GRS	BASIC	Graphe d'un système d'équations du premier degré.
GR2	BASIC	Graphe d'une équation du second degré.
CMD	BASIC	Calcul du PPCM et du PGCD.
TEB	PL/1	Exercice sur les transformations d'une base à une autre.
SLT	BASIC	Résolution d'un système d'équations linéaires.

160 - Physics

PL#	BASIC	Etude de l'effet photoélectrique.
DA#	BASIC	Jeu sur la désintégration des atomes.
CI#	BASIC	Expérience de calorimétrie.
OT#	BASIC	Intégration de l'équation du mouvement.
W2#	BASIC	Jeu sur la deuxième loi de Newton.
RT#	BASIC	Jeu illustrant le chemin minimum en optique.
SE#	BASIC	Calcul d'orbites de satellites.
VD#	BASIC	Représentation d'un champ électrique.
BD#	BASIC	Représentation d'un champ magnétique.
DB#	BASIC	Calcul concernant la désintégration des atômes.

170 - Statistics

SS#	BASIC	Calcul de la moyenne de l'écart-type, du Z-score, du T-score et histogramme.
FQ#	BASIC	Trace l'histogramme d'une série de notes.
ST#	BASIC	Analyse de données de laboratoire.

180 - Demonstrations and games

BS#	BASIC	Recherche d'un nombre de trois chiffres.
NIM	PL/1	Jeu des allumettes.

190 - Administration

BC#	BASIC	Balance commerciale - balance des paiements.
BK#	BASIC	Résolution de problèmes sur les taux d'intérêt.
SK#	BASIC	Simulation de placements en bourse.

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